

3. On the Structure and Affinities of some new Species of Molluscs from Borneo. By WALTER E. COLLINGE, F.Z.S., Assistant Lecturer and Demonstrator in Zoology and Comparative Anatomy, Mason College, Birmingham, and Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S., F.Z.S., &c.

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### I. INTRODUCTION.

The molluscs which form the subject of this paper were some collected by Mr. A. H. Everett in Borneo and forwarded to Mr. Edgar A. Smith of the British Museum, who very kindly placed them in the hands of one of us (W. E. C.) for investigation.

While fully describing the species, we have thought it necessary and important to treat at some length of the affinities structurally and externally, and to compare them with other genera and species of the Indian and Malayan fauna, upon which one of us (H. H. G.-A.) has worked for some considerable time.

The perfect specimens and the dissected parts have all been placed in the collection of the British Museum, South Kensington.

It is sincerely to be hoped that further Bornean material will be obtained, as there are probably not a few very interesting forms in that region which bridge over the gaps that at present

exist between the slug-like molluscs and those possessing a more perfect shell; further, an investigation of their anatomy is likely to throw considerable light upon the relations and position of such genera as *Parmarion*, *Microparmarion*, *Damayantia*, and *Mariella* on the one hand, and *Girasia*, *Austenina*, *Ibycus*, and *Macrochlamys*, &c. on the other.

#### DAMAYANTIA, Issel, 1874.

##### II. DAMAYANTIA SMITHI, n. sp.

*Shell* (fig. 4) broadly oval, with a slight indication (a mere impression) of the apical whorl, the whole of an equally membranaceous and thin texture, transparent, shiny; when removed from the animal in alcohol it becomes much contracted by wrinkling, in the fresh state it would be convex in outline and of a pale olivaceous colour.

Major diameter about 12 millim.

*Animal* (figs. 1-3).—Ground-colour pale ochre in alcohol, tentacles black or very dark blue, a very dark blue or black streak runs along the side of the foot posteriorly, crossing it diagonally downwards to the mucous pore. The dorsal lobes are streaked and mottled with jet-black on a yellowish-grey ground, this being more conspicuous anteriorly. The black markings on the shell-lobes are concentrically arranged as regards the edge of the shell: in the specimens examined they are probably much contracted, but in life would cover the greater portion of the shell; they are probably very similar in size to those of *Damayantia dilecta*, Issel (4. pl. iv. figs. 5, 6).

The mantle differs very much from that of the typical *Girasia* (1); in this Bornean slug the left shell-lobe has been developed to a greater extent than the right, and extends back behind the respiratory orifice, even posterior to the apex of the shell, and it is clearly defined by the white edging. On the left anterior margin a cicatricial line marks very distinctly where the shell and dorsal lobes meet. The left and right are continuous all round, the left being the larger and concealing the head of the animal. The foot posteriorly is long and narrow, sharply keeled, and terminates abruptly. Foot-sole divided into three distinct planes, faintly marked with transverse lines, colour yellowish brown. Foot-fringe slightly darker than the foot-sole; two rows of elongated rugæ arranged in parallel rows lie above the foot-fringe. Large linear mucous pore (fig. 6) not extending to the foot-sole. The pallial margin is well marked, as is also the pallial line, which is deeply crossed by grooves into oblong spaces.

The animal in alcohol measured 28 millim. in length, breadth of foot-sole in the anterior region  $4\frac{1}{2}$  millim.

*Hab.* Poeh Mountain (3500 ft.), Sarawak (*A. H. Everett*).

It gives us much pleasure to associate with this most interesting mollusc the name of Mr. Edgar A. Smith, F.Z.S., of the British Museum.

1. *Anatomy.*

*Visceral Mass, &c.*—On removing the shell, the visceral mass presents a single coil (fig. 5), the apical portion being distinct and terminating bluntly.

The jaw (fig. 7) is straight and narrow, very slightly concave on the cutting-edge, with a straight central portion less than one-third of the whole breadth. The lingual ribbon (fig. 8) is broad and square, having a great number of equal-sized and similarly-shaped teeth in the row. The lingual ribbon was incomplete in the specimen examined, but the following were counted:—175—1—175. The central tooth is elongate with three points close upon the same level, *fleur-de-lis* in form, contracting below this and widening again at the base. The succeeding lateral teeth are all uniform, curved, very elongate, with two closely-set points, the outermost being rounded and the innermost sharp and pointed.

*Generative Organs* (figs. 9–12).—From the somewhat large thick-walled vagina the penis passes off; its first third is a thick muscular-walled tube which dilates into a more sac-like portion, above which it becomes suddenly constricted, and then dilates into a bulbous head (figs. 10 & 11). Attached to the upper portion of the penis, above the vas deferens, is a short but strong retractor muscle (figs. 10 & 11, *r.m.*). From the side of the bulbous head of the penis the vas deferens passes off as a thick tube narrowing gradually as it approaches the prostatic portion of the common duct. The free oviduct commences immediately above the opening of the receptaculum seminis, this latter organ opening into the vagina; it is a small ovoid sessile body (fig. 9, *r.s.*). The first portion of the free oviduct (fig. 9, *ov'*) is thrown into a series of constrictions. The oviduct is a wide tube and densely folded, the prostatic and oviducal portions terminate in a bulbous head lying immediately in front of the globular albumen-gland. The hermaprodite gland is almost circular and appeared flattened, showing a slight fold or indentation in the centre. The amatorial organ is a large, wide, thick, muscular-walled tube, making a single coil above the middle half, which would increase its elasticity and act like a spiral spring; just below this is the calcareous dart. Its basal portion is funnel-shaped, the dart itself being long and pointed (fig. 12).

2. *Affinities.*

*Damayantia smithi* is in every way a most interesting species, differing in many important particulars from *Girasia* and its allies of the Indian Region, of which the following may be mentioned:—

1. The spiral form of the visceral mass is very noticeable, and we probably have here indicated a relationship with forms having a more perfect spiral shell. In *Girasia*, when the shell is removed, this is not apparent.

2. The form of the mantle-lobes indicates a relationship to some form in which the left shell-lobe has become largely developed along the whole mantle-edge together with the right, as displayed in *Girasia* and *Macrochlamys*, but in which last-named the development of the shell-lobes has been more equal and commenced at two distinct points.
3. The position and form of the caudal mucous gland.
4. The straight jaw.
5. The broad lingual ribbon and great number of teeth of a very different form.

While not inclined to attach any great importance to these two last-mentioned characters, we consider them of sufficient value to place this mollusc in the subfamily *Durgellinae*.

On comparing *Damayantia smithi* with *Tennentia philippinensis*, Semper (6), we find it differs in the presence of the coil in the amatorial organ and in the form of the central tooth. The separation between vagina and free-oviduct also differs. *Tennentia* is probably synonymous with Issel's genus. It was founded by Humbert on a species from Ceylon, viz. *T. thwaitesi*, which is only a synonym of *Mariella dussumieri*, Gray, said to be from Mahé in the Seychelles. The genus *Dekhania*, Godwin-Austen, type *beddomei*, G.-A., is also the same as *Mariella*, and must be suppressed.

Issel (4) in 1874 figured and described three species of slugs from Sarawak, one of which, *dilecta*, is the type of a new genus founded by him, viz. *Damayantia* (4. figs. 4 & 6), on external characters only. This is shown to have exactly the same peculiar concentric markings on the mantle as *Damayantia smithi*, and in spite of the statement of Issel that there is no shell, we believe them to belong to the same genus. These very thin membranaceous shells may easily escape notice; and, further, in all the species from the Indian region, to which one of us (H. H. G.-A.) has devoted special attention, a shell is always present, however small and membranaceous in size and texture it may be reduced to.

The two other species recorded by Issel are *D. dorice* (pl. iv. figs. 7 & 8) and *D. beccarii* (pl. iv. figs. 9, 10, & 11). The latter has a thin immature shell (fig. 10), but the jaw figured (fig. 11) has a strong central projection. Issel has placed them in the genus *Parmarion*.

#### MICROPARMARION, Simroth, 1893.

##### III. MICROPARMARION POLLONERAI, n. sp.

*Shell* (fig. 13) flat and expanded, auriculate, the apex white, shelly, the rest olive-green, membranaceous yet solid; two whorls.

Major diameter 16 millim., minor diameter 10 millim.

The posterior side of the shell is very thin and diaphanous and falls around the edge of the shell, covering the side of the visceral mass. In this respect it recalls the shell of the South Indian *Africanion palleis*, "Morel.," G.-A.; but here the similarity ceases,

and the extremity of the foot and the hollow in which the body rests are quite different.

*Animal* (figs. 14-16), in alcohol, of a bluish<sup>1</sup>-grey colour, dorsum dark blue. The foot-sole is divided into a median and two lateral planes, the former being yellow; the lateral planes were probably much darker—a dark blue or sepia—when received they had a dark green appearance, which has gradually faded as fresh alcohol has been added. Foot-fringe deep and well marked, lineoles chocolate-brown. The extremity of the foot is truncate. Mucous pore a narrow vertical slit (fig. 15) not extending to the sole of the foot. The mantle-lobes are yellowish brown in colour and smaller than in *Damayantia smithi*, extending around and over the margin of the shell, but leaving a large portion visible. It is almost impossible to remove the shell without tearing away the flat and more solid upper surface of the last whorl, which really forms the first whorl, from the apex and the thin membranaceous covering at the back, because the apical portion, as will be seen from the figures (figs. 16 & 17), holds the posterior end of the visceral sac, which forms a large and distinct closely wound spiral.

*Habitat.* Paka Paka, Kina Balu (10,000 ft.), on leaves (*A. H. Everett*).

We have named this species after Signor Carlo Pollonera, the distinguished Italian malacologist of Turin.

*Microparmarion pollonerai* at first sight may appear to be not unlike *Damayantia smithi*, but the shell is far better developed, with a corresponding reduction of the shell-lobes, and the colour of the posterior portion and foot-sole differs also.

### 1. *Anatomy.*

*Visceral Mass, &c.*—The salivary glands (fig. 21) lie one on either side of the œsophagus. The jaw (fig. 18) is strong and solid, well arched above, with a large central projection on the cutting-edge, which is very slightly concave. The lingual ribbon (figs. 19 & 20) has the formula

$$\begin{array}{c} 60-25-1-25-60 \\ 85-1-85. \end{array}$$

The centre tooth has two cusps at the base of the centre point; the median teeth are large and broad, with an outer basal cusp, the succeeding laterals being much curved and more equally bicuspid.

*Generative Organs* (figs. 22, 23, 24, 25).—There is a wide sac-like vagina from which arises the receptaculum seminis, a somewhat irregular-shaped sac. As in *Damayantia smithi*, there is no duct. The penis is a thick elongated muscular sheath; the vas deferens passes off as a narrow tube from the posterior end, in life it lies

<sup>1</sup> Wherever a green colour was present in the alcoholic specimen, it is here spoken of as blue,

along the inner side of the penis and on the side of the vagina and free oviduct. The retractor muscle has its attachment some little distance below this, close to the point where the thickened flagellum (calc-sac) terminates (fig. 23). The interior lining of the flagellum has a beautifully papillated surface (fig. 24), the raised portions being renate in form and directed forwards, somewhat like the teeth of a coarse file. The prostatic and oviducal canals, forming the common duct, are thrown into a series of sharp folds, which are not without some difficulty unwound. The albumen-gland is large and somewhat pyriform in shape. The hermaphrodite gland is a small oval-shaped body with a short thin tube attached—the hermaphrodite duct. The amatorial organ (fig. 22) has a sharp coil about midway in its length, with the large swelling glandular mass above; immediately below the coil, where the sheath narrows, is a calcareous dart (fig. 25) funnel-shaped at the base.

#### IV. MICROPARMARION SIMROTHI, n. sp.

*Shell* (fig. 28) oval in form, solid, olivaceous amber-colour, the lines of growth very strongly and regularly marked; apex small, white with a deep suture. There is an indication of its having had two and a half whorls when very young, the last whorl being covered again by the more mature and later formed shell of the last whorl.

Major diameter 17 millim., minor diameter 10 millim.

*Animal* (figs. 26 to 29). Colour variable, posterior portion mottled with chocolate and brown; median region yellowish brown; anterior and dorsal regions similar, with two very conspicuous black bands, one on either side of the head, separated from a central black band, which passes between the tentacles over the head, by pale lines running from the base of the tentacles. The sides of the head and foot are mottled and spotted; mantle also, but to a much greater extent. Shell-lobes closely papillated. Foot-sole divided into three planes, of which the median one is the largest, all marked with faint transverse lines; foot-fringe marked with broad chocolate-brown lineoles. Immediately above the foot-fringe is a distinct line or groove, which marks off the whole of the upper portion of the animal from the foot-sole (fig. 29).

Length in alcohol 31 millim., breadth of foot-sole in the anterior region 5 millim.

*Habitat.* Paka Paka, Kina Balu (10,000 ft.), on leaves (*A. H. Everett*).

With this species we have associated the name of Dr. Heinrich Simroth, the distinguished malacologist of Leipzig, and founder of the genus.

#### 1. *Anatomy.*

*Visceral Mass, &c.*—The salivary glands are similar to those described in *Microparmarion pollonerai*, as are also the jaw and

form of the teeth. The lingual ribbon was extracted in a very perfect state, showing one hundred rows of teeth arranged thus

90—16—1—16—90  
106—1—106.

*Generative Organs* (figs. 32-35).—The vagina is larger than in *M. pollonerai*, as is also the sessile receptaculum seminis, which is somewhat pyriform in shape. The penis opens into the vestibule as a comparatively narrow tube, but as it approaches the vas deferens it dilates into a large sac-like head, from which the flagellum arises; the latter organ is looped back upon itself and of the same diameter throughout, terminating blindly. In one specimen it was somewhat produced, as shown in figure 34. The vas deferens leaves the head of the penis as a wide tube, becoming narrower in the middle and dilating again previous to entering into the prostate. The common duct is similar to that in *M. pollonerai*, only not so richly convoluted; it differs also in being much straighter and not coiled upon itself as in *M. pollonerai*. The albumen-gland is small and ovoid. The hermaphrodite gland is small and triangular in shape, with a thin convoluted duct.

## 2. Affinities.

The nearest species as regards internal anatomy to either of these two species of *Microparmarion* is *Parmarion pupillaris*, Humb., from Java, notwithstanding the fact that the shell is very rudimentary. It is figured by von Martens (5. pl. xii. fig. 3), who localizes *Parmarion* to this part of the world. The generative organs are figured by Semper (6), whose figure we have reproduced for purposes of comparison. The form of the penis and receptaculum seminis and amatorial organ are very different from those in either of the species here described. The dart is cut off like a pen near the point (fig. 37). In the jaw and lingual ribbon there is a complete analogy.

A comparison, however, of all the characters with those of *Girasia* of India and Burma shows that these Malayan forms differ sufficiently to constitute them a distinct race; and if we could only obtain more material, in which other characters, such as the spermatophore, might be examined, a still greater divergence would, we think, be found associated with the small sessile receptaculum seminis.

Simroth (7), in his latest paper on these slug-like land-molluscs, very rightly divides the genus into two, viz., *Parmarion* and a new genus *Microparmarion*, distinguishing this latter by the sessile receptaculum seminis and solid *sagitta amatoria*. It will be seen that among the Javan forms figured by him on plates vii. and viii., *Microparmarion strubelli* agrees in some respects with *M. simrothi*, particularly in the calc-sac of the male organ and in the hard calcareous dart rising from the funnel-shaped base, and externally by the black lines on the dorsum and region of the head. In

*M. pollonerai* there is a tendency to change, as shown in the twisted amatorial organ and the form of the calc-sac.

## V. SUMMARY AND CONCLUSION.

The chief features on which we would base the specific distinctness of the afore-mentioned new species are as follows :—

### 1. DAMAYANTIA SMITHI.

*D. dilecta*, Issel, at present being known only from external features, we would point out that it differs from our species externally in the form and size of the mantle-lobes, the lesser development of the left lobe, and presumably in having a smaller and less solid shell than that possessed by *D. smithi*.

### 2. MICROPARMARION POLLONERAI.

The form, size, &c. of the penis and calc-sac are quite sufficient to separate this species from any already described. The densely convoluted common-duct and the sharp coil in the amatorial organ are also characteristic of this species.

### 3. MICROPARMARION SIMROTHI.

*M. strubelli*, Simr., is undoubtedly the nearest ally to *M. simrothi*. For purposes of comparison we have reproduced Simroth's figure (7. tab. viii. fig. 12) on fig. 39, and it will be seen that our new species differs from the former in the following details :—

- a. The larger and more perfect shell.
- b. The different form of the penis, albumen-gland, and hermaphrodite gland.
- c. The almost straight common duct (prostate and oviduct).
- d. The large amatorial organ.
- e. Less important differences in the form of the flagellum, vagina, and free oviduct.

There is, as one might expect, considerable similarity in these Bornean slug-like forms. This is shown in so many important organs, wherein they differ from the slugs of the Indian region, notably in the form of the dart, short sessile receptaculum seminis, and differently formed male organs, which would materially alter the form of the spermatophore. But perhaps the most interesting result of the examination of these slug-like molluscs is their similitude internally to the similar parts of shell-bearing species which inhabit the same island of Borneo. A reference to the figures and description of the genera *Everettia* and *Dyakia* (2) will show that the calcareous dart peculiar to *Microparmarion* occurs in both of these genera, while the odontophore of *Damayantia smithi* agrees with that of *Dyakia* in a remarkable manner.

It seems to us that there can be little doubt but that the slug-like forms of Borneo have the same close relationship to the shell-bearing molluscs among which they are now found living, as the



Indian forms bear to *Macrochlamys* and allied shell-bearing genera, and any true attempt at classification must be based on these lines, and would place a wide gulf between *Girasia* and *Austenia* on the one side, and *Parmarion* and *Microparmarion* on the other. Further, we think that future research will clearly show that many of the slugs cannot rightly be placed in families by themselves, but will find their true position before or after the genera they have descended from or developed into.

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## VII. DESCRIPTION OF THE FIGURES.

### PLATES XI.–XIV.

- Fig. 1. *Damayantia smithi*, n. sp. View from right side.  $\times 2.5$ .
2. *Damayantia smithi*, n. sp. View from left side.  $\times 2.5$ .
3. *Damayantia smithi*, n. sp. View from above.  $\times 2.5$ .
4. Dorsal view of shell.  $\times 2.5$ .
5. Visceral mass, showing spiral fold, *sp.f.*  $\times 2.5$ .
6. Caudal mucous pore.  $\times 8$ .
7. Jaw.  $\times 12$ .
8. Portion of lingual ribbon.  $\times 368$ .
9. Generative organs.  $\times 2.25$ .

### Lettering.

<i>alb.gl.</i> Albumen-gland.	<i>ov.</i> Oviduct.
<i>am.</i> Amatorial organ.	<i>p.</i> Penis.
<i>d.s.</i> Dart-sac.	<i>pr.</i> Prostate.
<i>f.</i> Flagellum.	<i>r.m.</i> Retractor muscle.
<i>h.d.</i> Hermaphrodite duct.	<i>r.s.</i> Receptaculum seminis.
<i>h.gl.</i> Hermaphrodite gland.	<i>r.s.l.</i> Right shell-lobe.
<i>l.d.l.</i> Left dorsal lobe.	<i>v.</i> Vestibule.
<i>l.s.l.</i> Left shell-lobe.	<i>v.d.</i> Vas deferens.
<i>ov'.</i> Free oviduct.	<i>vg.</i> Vagina.

Figs. 10 & 11. Upper portion of penis, from both sides.  $\times 3$ .

Fig. 12. Dart-sac and dart *in situ*.  $\times 8$ .

13. *Microparmarion pollonerai*, n. sp. Dorsal view.  $\times 2.4$ .